

Introduction of the Liver Fluke Snail Predator, *Sciomyza dorsata* (Sciomyzidae, Diptera), in Hawaii

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The liver fluke, *Fasciola gigantica* Cobbold, causes the most important parasitic disease of beef and dairy cattle in Hawaii. Up to 87 per cent of cattle livers are infested in some localities, and this results in considerable monetary loss to the ranch industry. The intermediate host of *F. gigantica* is the fresh-water snail, *Lymnaea ollula* Gould, which abounds in swamp, stream, taro and water cress habitats.

Berg (1953) studied larvae of the dipterous family Sciomyzidae and recognized them as killers of snails. Help was solicited from him and his associates at Cornell University to obtain suitable marsh flies for trial on the liver fluke snail in the State of Hawaii. Through his efforts and those of his former assistant, Dr. S. E. Neff, a very efficient snail-killing fly from Central America, *Sepedon macropus* Walker, was obtained. After study and insectary propagation this species was released, and it is now well established on the four major islands of the State (Chock, et al, 1961).

The aquatic larvae of *S. macropus* attack and kill active individuals of *Lymnaea ollula* in the water. Individuals of *L. ollula* also occur out of water, either leaving it voluntarily or becoming stranded in drying ponds and marshes. To bring predatory pressure against such exsiccated snails, the introduction of a sciomyzid species having terrestrial larvae seemed highly desirable.

In connection with studies of European Sciomyzidae supported by grants from the National Institutes of Health and the National Science Foundation in 1960, Dr. Berg and technical assistant L. V. Knutson searched for a promising terrestrial species. *Sciomyza dorsata* Zetterstedt was collected in Denmark, where its natural history was studied by Knutson. Since many of the desired attributes are combined in this species, it was airmailed to Hawaii in August and October.

The first shipment consisted of five adult flies. Although progeny were obtained, the stock failed to respond to our methods. The second shipment consisted of 80 puparia, from which 61 healthy adults emerged. Propagation was very successful; 2,040 first generation, 6,008 second generation, and 12,592 third generation flies were obtained.

Under laboratory conditions here, with temperatures varying from 73 to 87

degrees Fahrenheit, the minimum life cycle of this species is 20 days. This cycle is broken down as follows:

Egg	Larva	Pupa	Preoviposition Period	Total
2 days	7 days	7 days	4 days	20 days

The cycle is 5 or 6 days shorter than that of *Sepedon macropus* and the larvae appear to feed more voraciously than those of *S. macropus* on fresh-water snails.

BREEDING METHODS

Adults: A breeding stock of 25 adult flies is held in a wide-mouth gallon jar which is covered with a piece of white organdy cloth secured with a rubber band. The jar is placed horizontally, and a petri dish of wet, green algae or dampened peat moss is placed inside. Ten or 12 living liver fluke snails are placed amongst the moss to induce egg laying. The flies are fed daily with a mixture of honey, water and brewers' yeast. This is accomplished by dotting the inside surface of the jar with this food by means of a small camel's hair brush. To maintain a healthy colony, the flies are collected and transferred to a clean jar at least twice a week. Under these conditions, the adults live and oviposit for as long as 48 days.

Eggs: The slender, white eggs are deposited singly on the algae or moss. Each day the vegetation, eggs, and snails are removed and fresh algae or moss and snails are substituted. This procedure is continued until a new breeding stock is desired, when the old flies are released for field colonization. The recovered eggs and a few small snails are placed on a layer of dampened peat moss in a glass tumbler. The tumbler is then covered with a piece of cloth and set aside until the eggs hatch.

Larvae: The newly hatched larvae immediately attack the snails, several being found commonly in one snail. The larvae are held in this manner until the 5th day of development, when everything in the tumbler is transferred to a gallon jar. Living *Lymnaea*, *Physa* and *Melania* snails (*Melania granifera mauiensis* Lea and *Melania newcombi* Lea) are provided daily until pupation, usually the 7th day. The jar is then set aside for adult emergence.

Although food preference tests were not conducted, it was evident from hundreds of feedings that *S. dorsata* larvae preferred these aquatic snails in the following order: *L. ollula*, *Physa compacta* Pease, *Melania mauiensis*, and *M. newcombi*. The terrestrial snails *Achatina fulica* Bowdich and *Bradybaena similaris* (Ferrusac) were accepted in a lesser degree.

Puparia: Because the red or reddish brown puparia are found almost exclusively inside the emptied snail shells, old shells are never removed from the rearing jar and discarded. A few puparia are found in the moss.

Moisture: Throughout the developmental period—from egg through the pupal stage—the peat moss is kept just at the point of saturation. If too much moisture accumulates, a bit of dry peat moss is added to absorb the excess.

HOST RANGE TESTS AND LIBERATION

The propagation of *S. dorsata* not only involved several species of aquatic snails but also demonstrated experimental acceptance of some terrestrial species. Consequently, prior to liberation, host range tests were conducted on the beautiful and aesthetically desirable native tree snail, *Achatinella stewartii* var. *producta* Reeves, and on the introduced carnivorous snails *Gonaxis kibweziensis* (Smith), *G. quadrilateralis* (Preston) and *Euglandina rosea* Ferrusac. These tests were summarized in a dittoed report, written by us, titled "Host Range Studies of the Introduced Liver Fluke Snail Predator, *Sciomyza dorsata* Zetterstedt," and dated December 6, 1960. They demonstrated conclusively that under simulated natural conditions the native arboreal snail was not attacked. Although the terrestrial carnivorous snails *G. quadrilateralis* and *E. rosea* sustained minor predation, *G. kibweziensis* was unaffected. It was learned subsequently that the carnivorous snails often resisted attack by ingesting the attacking larvae! Since these host range studies indicated that *S. dorsata* would not jeopardize populations of the native tree snail and introduced carnivorous snails under natural conditions, this sciomyzid was released from quarantine and turned over to the insectary staff for propagation and liberation.

The first release was made at Heeia, Oahu on 8 December, 1960, and since then many thousands have been liberated throughout the major islands of the State.

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